

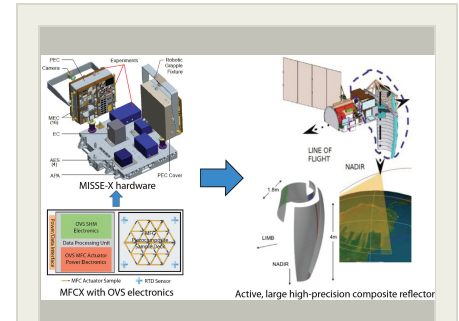
On-Orbit Validation System for Space Structure Composite Actuators, Phase I

Completed Technology Project (2013 - 2013)



Project Introduction

This SBIR project delivers an On-orbit Validation System (OVS) that provides performance and durability data for Macro Fiber Composite (MFC) active piezocomposite materials operating in the space environment. Our NASA customer is the Macro Fiber Composite Actuator Experiment (MFCX), which uses the Materials International Space Station Experiment-X (MISSE-X) platform. MISSE-X will expand ISS utilization by advancing the Technology Readiness Level of new materials, devices, and subsystems. OVS uses the impedance method to validate both MFCs and in situ self-health monitoring methods. Implications of the innovation: MFC piezocomposites have been flown, but only in a shielded enclosure for a short duration. MFC materials will need to operate continuously with minimal thermal protection to enable active composite reflector structures, large solar array active control, and structural self-health monitoring. Data is needed on the viability of MFC materials for long-duration space applications. Technical objectives: OVS leverages our previous NASA SBIR research. Our initial impedance method prototype exists as a TRL 5 unit. We have demonstrated both analog and digital MFC operation. However, it is not clear which approach (analog or digital) is best for OVS. Each approach has different power, mechanical, electrical, and computational needs—it is not clear which is the best match for MISSE-X. Indeed, a new configuration may be required. Phase I addresses these concerns and establishes feasibility through validation tests and experiments. Research description: We have already developed an impedance-based electronics package and validated it under simulated launch conditions. Phase I transforms this implementation for MISSE-X compatibility and produces a Phase II road map. Anticipated results: Phase I addresses the main barrier to MISSE-X operation, and completes a TRL 5 prototype that is MFCX compatible. Phase II delivers a fully operational TRL 7 unit.



On-orbit validation system for space structure composite actuators

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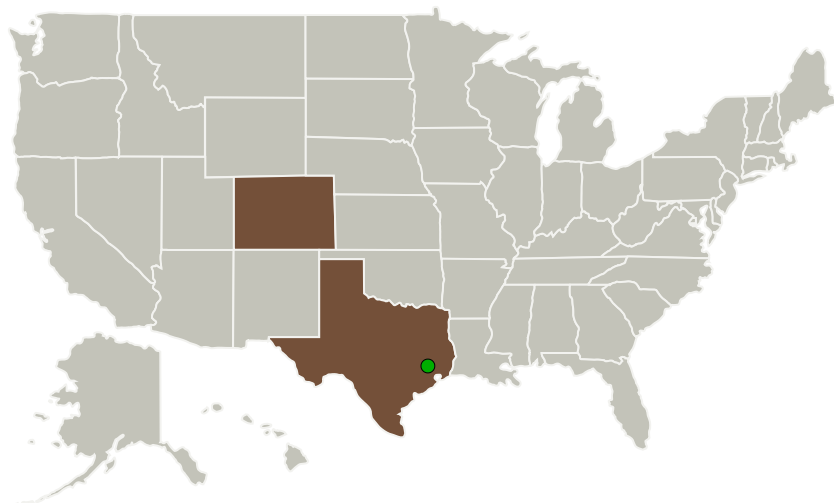
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Extreme Diagnostics, Inc.	Lead Organization	Industry	Boulder, Colorado
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

Colorado	Texas
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Project Transitions

▶ **May 2013:** Project Start

✓ **November 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138386>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Extreme Diagnostics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert B Owen

Co-Investigator:

Robert Owen

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The diagram illustrates the architecture of the Active Large High-Precision Composite Reflector (ALHPRCR). It is divided into three main sections: Hardware, Software, and System Operation.

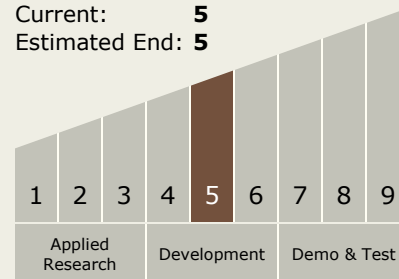
Hardware (MISSE-X hardware): This section shows a 3D perspective view of the hardware components. The components include a Camera, Exposure, Stable Image Plate, MFC, BC, MFC, ANK, and FPC Cover. A blue arrow points from this hardware to the software section.

Software (MFCX with OVS electronics): This section shows a 2D view of the software components. The components include OVS 3448 Electronics, Data Processing 20K, and MFCX with OVS electronics. A blue arrow points from this software to the system operation section.

System Operation: This section shows the system's operation. It includes a 3D view of the reflector's active surface, which is a large, curved, and segmented structure. The diagram shows the "LINE OF FLIGHT" and the "NADIR" (the point directly below the reflector). The reflector's surface is composed of many small, active, high-precision composite reflectors.

(<https://techport.nasa.gov/image/134238>)

Start: **5**
Current: **5**
Estimated End: **5**



- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.3 Mechanical Systems
 - └ TX12.3.2 Electro-Mechanical, Mechanical, and Micromechanisms

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System